

## REMARKS

Claims 1 – 19 are pending in this application. Claim 20 was cancelled in the previous amendment. Claim 1 has been amended and new claims 21 – 36 have been added.

### NEW CLAIMS AND AMENDMENTS

The amendment of claim 1 and new claims 21 – 36 are fully supported in the application as originally filed and no new matter has been added.

Independent claim 1 has been amended so that the claimed stroke multiplying shape memory alloy actuator includes a recess formed in the heat sink that separates the ends of at least one SMA wire from the heat sink. This limitation is directed towards one of the key advantages of the stroke multiplying shape memory alloy actuators of the present invention, namely, increasing the effective operating length of the shape memory alloy wires. The effective operating length of the shape memory alloy wires is related to the amount of the shape memory alloy wire heated above the austenite finish temperature ( $A_f$ ). The central portion of the shape memory alloy wire is cooled primarily by the proximity of the shape memory alloy wire to the heat sink. The ends of the shape memory alloy wire are not only cooled by the proximity of the shape memory alloy wire to the heat sink but also by conduction where the ends of the shape memory alloy wire attach to the rigid member. Because there are two modes of heat transfer at the ends of the shape memory alloy wire, the ends of the shape memory alloy wire often remain below  $A_f$ . The use of a recess in the heat sink reduces the heat transfer related to the proximity of the shape memory alloy wire to the heat sink. By reducing one of the heat transfer mechanisms operating on the ends of the shape memory alloy wires, more of the shape memory alloy wire near the ends is heated above  $A_f$ . Thus, the benefit of increasing the effective operating length is obtained, by forming a recess in the heat sink that separates the ends of at least one SMA wire from the heat sink. This operation is discussed in the specification on page 11.

New claim 21 depends from newly amended claim 1 and adds the limitation that one of the rigid elements of the sliding plane shape memory alloy actuator act as the heat sink. This claim limitation is directed towards another advantage of shape memory alloy actuators of the present invention over conventional shape memory alloy actuators, namely, where a separate heat sink is not required. By utilizing a rigid element of the shape memory alloy actuator as the heat sink, embodiments of the present invention have the advantages of simplicity of design and

cost reduction through the lack of need for an external heat sink. In addition, the rigid member heat sink moves and re-shapes itself through the movement of the rigid members as the shape memory alloy wires contract and expand. This advantage is discussed in the specification on page 11.

New independent claim 22 is directed towards a shape memory alloy actuator that includes the advantageous features of forming a recess in a rigid planar elongate member and attaching the shape memory alloy wire to the rigid planar elongate member adjacent the recess. The benefits of using shape memory alloy actuators having rigid planar elongate members with recesses is set forth above with regard to claim 1. Support for this claim and the additional limitations of dependent claims 23, 24, 25 and 26 are found on pages 11, 16 – 18 and in Figures 7, 8A and 8B.

New independent claim 27 is directed towards a sliding plane shape memory alloy actuator with a rigid member having the beneficial recess feature described above. In addition, this claim is directed towards the beneficial use of the at least two different heat transfer mechanism at work in these embodiments of the present invention. A first heat transfer mechanism dominates the heat transfer between the central portion of the shape memory alloy wire and the rigid member. A second different heat transfer mechanism dominates the heat transfer between the rigid member and the portion of the shape memory alloy wire proximate to the portion of the rigid member having the recess. The recognition and beneficial utilization of these two heat transfer mechanisms to improve the operational capabilities of the sliding plane shape memory alloy actuators of claim 27 and dependent claims 28 – 32 are discussed in the specification on at least pages 16 – 18 and Figures 7, 8A and 8B.

New independent claim 33 is directed towards a sliding plane shape memory alloy actuator that beneficially utilizes the heat transfer mechanism common to the ends and the central portion of the shape memory alloy wire. The heat transfer mechanism common to the ends and the central portion of the shape memory alloy wire is the spacing between the shape memory alloy wire and the rigid member. The shape memory alloy wire is spaced from the rigid member at a first spacing in the central portion and at a second spacing at the ends. The beneficial use of the spacing between the shape memory alloy wire and the rigid member provides, at least, the advantages described above and the increase in shape memory alloy wire operational length. The recognition and beneficial utilization of the heat transfer mechanism

common to the central portion and ends of the shape memory alloy wire to improve the operational capabilities of the sliding plane shape memory alloy actuators of claim 33 and dependent claims 34-36 are discussed in the specification on at least pages 16 – 18 and Figures 7, 8A and 8B.

### **Rejections under 35 USC 102**

The Examiner has rejected claims 1-3, 14-15, 17-18 under 35 U.S.C. 102(e) as being anticipated by U.S. 6326707 (Gummin '707).

Independent claim 1 is distinguishable over Gummin '707 in at least that Gummin '707 provides no teaching or suggestion regarding the placement of an SMA wire relative to a heat sink. Specifically, in newly amended claim 1, applicant claims a stroke multiplying shape memory alloy (SMA) actuator comprising ... rigid parallel elongate members ... connected one to another by an SMA wire ... where at least the central portion of the SMA wires are in close proximity to a heat sink and a recess formed in the heat sink separates the end of at least one SMA wire from the heat sink.

Since Gummin '707 provides no teaching or suggestion for the claimed “recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink”, Gummin '707 does not anticipate or render obvious Applicant's independent claim 1. Withdrawal of the 35 USC 102 (e) rejection of claim 1 under Gummin '707 is respectfully requested. Claims 2, 3, 14, 15, 17 and 18 all depend from allowable claim 1. Therefore, Applicant respectfully requests the withdrawal of the 35 USC 102 (e) rejection of claims 2, 3, 14, 15, 17 and 18 under Gummin '707 as well.

The Examiner rejected claim 20 under 35 U.S.C. 102(e) as being anticipated by U.S. 5165897 (Johnson '897). Claim 20 was cancelled by previous amendment.

The Examiner provisionally rejected claims 1-20 under 35 USC 102 (e) as being anticipated by U.S. Patent Application Serial 09/637,713. Claim 20 was cancelled in the previous amendment.

Independent claim 1 is distinguishable over U.S. Patent Application Serial 09/637,713 (Application '713) in at least that Application '713 provides no teaching or suggestion regarding applicant's claimed stroke multiplying shape memory alloy actuator. In newly amended independent claim 1, applicant claims a stroke multiplying shape memory alloy (SMA) actuator comprising ... rigid parallel elongate members ... connected one to another by an SMA wire ...

where at least the central portion of the SMA wires are in close proximity to a heat sink and a recess formed in the heat sink separates the end of at least one SMA wire from the heat sink.

Application '713 provides no teaching or suggestion regarding the claimed "a recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink." As such, Application '713 does not anticipate independent claim 1. Applicant therefore requests the withdrawal of the provisional rejection of claim 1 under 35 U.S.C. 102 (e) as anticipated by Application '713. Claims 2 - 19 all depend from allowable claim 1. Therefore, Applicant respectfully requests the withdrawal of the 35 USC 102 (e) provisional rejection of claims 2 - 19 under Application '713.

#### **Rejections Under 35 U.S.C. 103(a)**

The Examiner has rejected claims 4 and 5 under 35 U.S.C. 103(a) as being unpatentable over the combination of Gummin '607 and U.S. Patent 2, 518, 941 to Satchwell et al (Satchwell '941).

Claims 4 and 5 depend from independent claim 1. Independent claim 1 is distinguished over Gummin '707 above.

Satchwell '941 describes a regulator for a heating apparatus. Satchwell '941 provides no teaching or suggestion related in any way to the claimed stroke multiplying shape memory alloy actuator "where at least the central portion of the SMA wires are in close proximity to a heat sink and a recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink." As such there is no combination of Gummin '707 with Satchwell '941 that renders obvious Applicant's independent claim 1. Because claims 4 and 5 depend from allowable claim 1, Applicant respectfully requests that the withdrawal of the rejection of claims 4 and 5 under 35 U.S.C. 103 of Gummin '707 in view of Satchwell '941.

The Examiner has rejected claims 6-13 and 16-18 under 35 U.S.C. 103 (a) as being unpatentable over Gummin '607. The Examiner contends that Gummin '607 discloses all of the claimed subject matter of independent claim 1 and that it would have been obvious to one of ordinary skill in the art to modify the actuator of Gummin '607 to the claimed dimensions.

As set forth above, independent claim 1 is distinguishable over Gummin '707 in at least that Gummin '707 provides no teaching or suggestion regarding the placement of an SMA wire relative to a heat sink having recessed features formed therein. As such, independent claim 1 is patentable over Gummin '707. Because claims 6-13 and 16-18 depend from allowable claim 1,

Applicant respectfully requests the withdrawal of the 35 U.S.C. 103 (a) rejection of claims 6-13 and 16-18 as unpatentable over Gummin '707.

The Examiner has rejected claim 19 under 35 U.S.C. 103 (a) as being unpatentable over the combination of Gummin '607 and U.S. Patent 5,165,897 to Johnson (Johnson '897). The Examiner contends that Gummin '607 discloses all of the claimed subject matter of claim 1 but does not disclose the actuator having a switch of a power circuit.

Claim 19 depends from independent claim 1. As set forth above, independent claim 1 is distinguishable over Gummin '707 in at least that Gummin '707 provides no teaching or suggestion regarding the placement of an SMA wire relative to a heat sink where the heat sink has a recess formed therein.

Johnson '897 describes a programmable tactile stimulator array system and method of operation. Johnson '897 provides no teaching or suggestion related in any way to the claimed stroke multiplying shape memory alloy actuator "where at least the central portion of the SMA wires are in close proximity to a heat sink and a recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink." As a result, no combination of Gummin '707 with Johnson '897 will render obvious Applicants dependent claim 19. Applicant therefore respectfully requests the withdrawal of the 35 U.S.C. 103 (a) rejection of dependent claim 19 as unpatentable over Gummin '707 in view of Johnson '897.

The Examiner provisionally rejected claims 1-20 under the judicially created doctrine of obviousness type double patenting as being unpatentable over the pending claims of copending U.S. Patent Application Serial 09/637,713. Claim 20 has been cancelled.

Amended independent claim 1 is distinguishable over U.S. Patent Application Serial 09/637,713 (Application '713) in at least that Application '713 provides no teaching or suggestion regarding the claimed stroke multiplying shape memory alloy actuator having "a recess formed in the heat sink separates the ends of at least one SMA wire from the heat sink." As such, Application '713 alone cannot render obvious Applicant's claimed invention. Applicant therefore requests the withdrawal of the provisional rejection of claim 1 under the judicially created doctrine of obviousness type double patenting. Claims 2 - 19 depend from allowable claim 1. Therefore, Applicant respectfully requests the withdrawal of the provisional

rejection of claims 2-19 under the judicially created doctrine of obviousness type double patenting.

In view of the foregoing, it is respectfully submitted that claims 1-19 are fully distinguished over the prior art of record and therefore are in condition for allowance, the prompt issuance of which is respectfully requested.

Accordingly, it is respectfully submitted that the pending claims 1-36 are fully distinguished over the prior art of record and therefore are in condition for allowance, the prompt issuance of which is respectfully requested.

If there are any outstanding prosecution matters that can be resolved through a telephone conference, the Examiner is requested to contact the undersigned attorney at 650-843-5798.

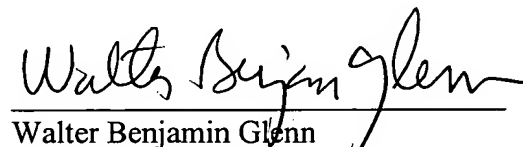
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Respectfully submitted,  
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